VOL. XXXIV. No. 2 APRIL, 1951

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MALAYAN AGRICULTURAL JOURNAL

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DEPARTMENT OF AGRICULTURE, FEDERATION OF MALAYA.

Kuala Lumpur.

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Malayan Agricultural Journal

Edited by the Agricultural Economist with the assistance of The Publicity Committee.

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THE
Malayan Agricultural Journal
APRIL, 1951.

EDITORIAL

Damage to Bunds. In this issue of the Journal Mr. D. S. Ferguson of the Drainage and Irrigation Department describes some of the experiments which have been tried out in an attempt to reduce the considerable amount of damage done to coastal bunds by lobsters and crabs which burrow in the soft mud under the bunds.

Mr. Ferguson points out that, although evidence is inconclusive, it is almost certain that the holes are made by the burrowing mud lobster *Thalassina anamola* and that the crabs only use the holes as a refuge.

Records are being kept, by officers of the Drainage and Irrigation Department, of the number of each species of lobster and crab found in the holes after they have been treated, and it is hoped that, in time, sufficient data will be available to distinguish definitely between the various species of burrowing and non-burrowing crustaceans found in bund holes.

Fodder Grasses. For many years it has been the common practice amongst the majority of cattle-keepers in Malaya to feed their animals on poor quality grass found growing on the way-sides or on unoccupied land near the towns and to supplement this feed with cut grass and concentrates fed in the stall.

Investigations were in progress prior to the war into the manurial requirements, the most suitable varieties and the cultural requirements of fodder grasses with a view to improving the quality and increasing the number of cattle in Malaya. These investigations were renewed in 1947, and an article in this issue reviews the work done between then and 1950.

Rubber Planting Material for Smallholders. It is estimated that of the 1,400,000 acres of rubber on holdings of under 100 acres in area, more than 1,250,000 acres are occupied by trees that are over 25 years old — trees that are past their prime and almost, if not already, uneconomic. This situation was appreciated by Government before the war and a scheme to provide improved planting material was started by the Department of Agriculture and the Rubber Research Institute in co-operation. Budwood nurseries were established in various parts of the country. The occupation of Malaya by the Japanese halted this attempt to improve the lot of the owners of rubber smallholdings, but the scheme was recommenced after the war and has, since 1949, been expanded with

assistance from Colonial Development and Welfare funds. An article by Mr. R. G. Heath, Chief Field Officer, Department of Agriculture, describes the objects of the scheme, some of the difficulties which have arisen and the progress made .

Introduction of Pests and Diseases into Malaya.

The arrival in Singapore of a pest which infests coconut palms (described in later pages) once again reminds us of the care needed to ensure adequate quarantine precautions.

With the expansion of air transport as a means of conveying passengers and freight from one part of the world to another in a matter of hours, the risk of introducing pests and diseases has multiplied very many times.

Fortunately, in the case of the pest referred to above, no less than five parasites have found and attacked the invader, and it is hoped that these parasites will control the pest sufficiently to prevent it from spreading.

CONTROL OF DAMAGE TO BUNDS BY BURROWING LOBSTERS AND CRABS.

BY

D. S. FERGUSON,

Deputy Director, Drainage and Irrigation Department.

Considerable sums of money are spent annually in repairing damage to coastal bunds caused by crabs and lobsters. These animals burrow in the soft mud under bunds and eject the spoil on to the surface round the edge of the hole. If no remedial measures are undertaken, local collapse of the bund in the vicinity of the hole is liable to occur due to the quantity of soil removed or more frequently due to erosion and enlargement of the hole caused by the flow of water through it at high tide if the burrow extends across the full width of the bund. Even if it extends only from the seaward side to a point underneath the bund, the hydrostatic pressure of the water at high tide may gradually cause extension of the hole to the inside of the bund by seepage of water along lines of weakness caused by rotten twigs and vegetation.

Crabs may frequently be seen entering and emerging from bund holes, but in the majority of cases the holes are not caused by these crabs but by a species of lobster known as *Thalassina anamola* (Fig. 1).

A very interesting and informative article entitled "Malaria and the Mud Lobster" was published in the June, 1942 issue of the *Transactions of the Royal Society of Tropical Medicine and Hygiene.* The article was contributed by Dr. J. W. Scharff, then Chief Health Officer, Singapore, and M. W. F. Tweedie, M.A., Director of Raffles Museum, Singapore.

The following extract from the article emphasises the distinction which must be made between the lobster which makes the hole and the crab which later uses it as a refuge.

" Before describing the control measures, however, we propose to give some account of the animal itself, as confusion exists concerning the author of the burrows and surrounding mounds of ejected mud which constitute the problem.

" Unfortunately, these burrows have come to be known as ' crab holes ' presumably because their most obvious inhabitants are certain species of large crabs belonging to the genus *Sesarma* (Fig. 2). These crabs use the burrows as a refuge, but do not make them. The holes and burrows are made by a crustacean which resembles a lobster or cray fish (Fig. 1.) which inhabits the soft mud underlying the superficial hard soil in brackish swampy areas. This mud lobster from time to time tunnels upwards to the surface, throwing out a quantity of mud around the opening of the burrow. After the burrow is open the animal periodically throws out more mud, presumably to keep the chamber at the bottom of the burrow from being obliterated by collapse of its walls. It follows

that *Thalassina* itself is seldom seen, and as the crabs which take refuge in the burrows are conspicuous, it is not surprising that the mud-hole and the crab have become associated in the minds of superficial observers."

The lobster, as may be seen from Fig. 1., is more than 6 ins. long, and the crab which frequents the holes is slightly smaller. Unfortunately, no hard and fast distinction can be made between burrowing and non-burrowing crustaceans, as some species of crabs are also capable of burrowing. Photographs of two such species (Figs. 3 and 4) are shown and Fig. 5 shows another variety of the *Sesarma* species which uses the burrow as a refuge only.

The *Metaplax* and *Uca* species of burrowing crab are considerably smaller than the harmless *Sesarma Versicolor*, and it is doubtful if they are capable of making any holes larger than the small ones found in tidal ditches or mangrove swamps. Evidence on this point is not conclusive, but for the time being efforts should be directed principally towards the extermination of the mud lobster (*Thalassina anamola*).

Records are kept of the number of each species of lobster or crab found dead after treatment of holes, and it is hoped, in the course of time, to collect sufficient data to distinguish definitely between the various species of burrowing and non-burrowing crustaceans found in bund holes. As such holes are usually about 2 ins. in diameter, it is unlikely that they could be made by a small species of crab.

A large variety of experiments have been tried out with varying success during the past few decades for reducing bund damage caused by burrowing lobsters (or crabs), and short summaries of the conclusions reached are given below:—

(a) A substantial bund, at least half a chain wide from toe to toe and with side slopes of about three to one, offers the strongest of all natural defences against burrowing crustaceans. The edge of the borrow pit from which the bund is formed should be at least half a chain from the toe of the bund.

Narrow bunds are frequently honeycombed after a few years whereas broad bunds are seldom attacked in force.

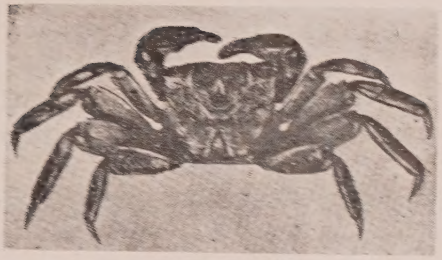
(b) Burrowing lobsters cannot survive in fresh water and are often found dead in large quantities inside bunds after heavy rains. Experiments have been carried out to reduce bund damage by building a secondary bund inside the main bund and keeping the space between filled with fresh water at a high level. These experiments were usually discontinued with inconclusive results after a short time due to practical difficulties, and the method is not recommended as it tends to interfere with drainage and irrigation control.

(c) The authors of the article "Malaria and the Mud Lobster" experimented with a mixture containing 2 lbs. of lime and ¼ lb. of Paris green dissolved in 3 gallons of water. The results were satisfactory but further investigations led to the conclusion that the lime was at least as toxic to the lobster as the Paris green. As it was considerably cheaper,

Fig. 1.

Large burrowing lobster.

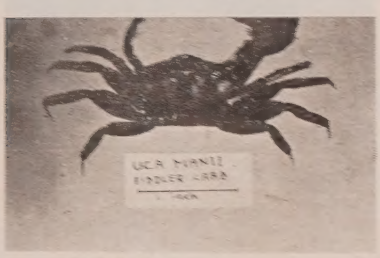
Fig. 2.



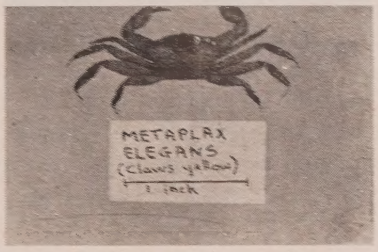
Large non-burrowing lobster.

ERRATUM

Malayan Agricultural Journal Vol. XXXIV, No. 2, April, 1951.
Fig. 2 facing page 62. For " Large non-burrowing lobster " read " Large non-burrowing crab ".



Small burrowing crab.

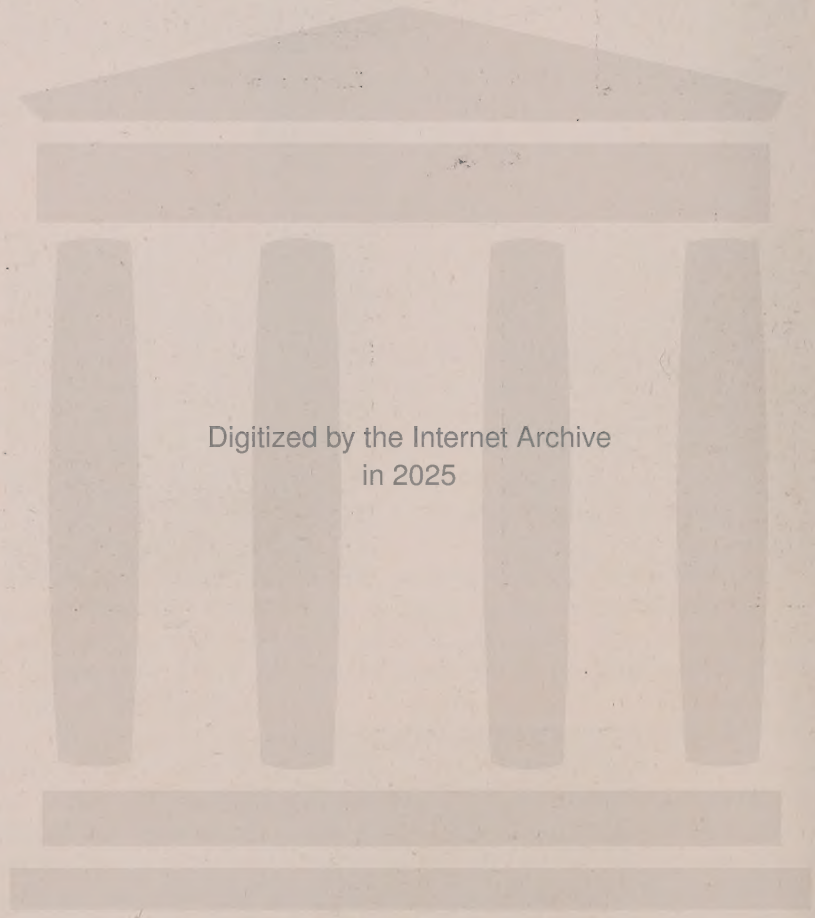


Small burrowing crab.

Fig. 5.

Large non-burrowing crab.

Photos reproduced by courtesy of M. W. F. Tweedie, M.A., Director, Raffles Museum, Singapore.



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a new mixture was prepared consisting only of 5 lbs. of freshly slaked lime suspended in 3 gallons of water. This was found to be very effective when used in quantities of ¼ to ½ gallon per hole. It had the added advantage of being cheap and safe to handle and was therefore recommended by the authors of the article for general use.

(d) Tuba root in the proportions of 2 lbs. of root to 3 gallons of water was also found to be effective, but the cost is considerably higher than the lime mixture.

(e) "Cyanogas" was tried out as long ago as 1936 but was not regarded as particularly effective.

(f) A somewhat similar trade preparation called "Cymag" is produced by Imperial Chemical Industries. It is supplied in powder form and releases the lethal gas Hydrogen Cyanide when in contact with moisture. The manufacturers recommend that it be applied by placing a teaspoonful in the hole, which is then sealed with a lump of clay. The gas released is said to kill any crabs or lobsters in the hole. In view of the fact that earlier experiments made with "Cyanogas" did not give very promising results, it would be unwise to expect too much from "Cymag".

Hydrogen cyanide gas is highly poisonous, hence the preparation should be handled with care. It has been used successfully by the Department of Agriculture for killing rats in burrows. It is injected into the burrows in powder form by a hand pump, all exits except the one into which the powder is injected being blocked with clay. The manufacturers state that it is also effective against land crabs but it has not as yet been tried out in this country to any extent. The cost is $10 per 7 lbs. tin. It is definitely worthy of trial.

(g) A "Slug Bait" manufactured by I.C.I. was tried out in Selangor and was stated to be completely ineffective.

(h) A cigarette tinful of a 50 per cent. solution of Jeyes fluid is very effective but the cost of such treatment is excessive.

(j) D.D.T. has been tried with inconclusive results. The chemical is insoluble in water and the solvent used, kerosene, is itself highly toxic to crabs (and presumably lobsters). Hence it is not clear whether the animals killed by the solution died due to the toxic effects of kerosene only or whether the D.D.T. was also effective.

(k) Crude oil has also been used at the rate of a cigarette tinful per hole but the results have not been satisfactory.

(l) Shell Co. manufacture a "D.D. Soil Fumigant" which has only recently been introduced into this country. It is as yet largely untried but the Company anticipate that it will be effective in killing crabs and lobsters.

It is sold in 40 lbs. drums (returnable) at a cost of 50 cents per lb.

It is a volatile liquid rather like petrol and is toxic either in the liquid or vapour form.

The method of use is as follows:—

Dip a piece of cotton wool (or cotton waste) into the liquid and then push it down the burrow. No further action is regarded as necessary if costs of application are to be kept at a minimum, but if the hole is plugged at the entrance with clay, a smaller quantity of the liquid could probably be used.

The liquid must be handled with care as it burns skin on contact rather like Jeyes fluid.

It should be worth a trial.

(m) A vertical cut-off wall or "iron curtain" of galvanized iron in the middle of the bund is effective, but the cost is prohibitive.

(n) A cut-off wall of the fibrous material formed on the trunks of coconut trees by the withering of leaf bases acts as an effective barricade when soaked in tar (Ref. "Malaria and the Mud Lobster".)

Summary.

(i) Substantially built bunds with side slopes of three or four to one and a base width of half a chain or more are usually immune to damage by burrowing lobsters or crabs. The borrow pits from which such bunds are formed should be at least half a chain away from the toe of the bund.

(ii) When funds available for bund maintenance are strictly limited, the best value per dollar expended is obtained by using a mixture of 5 lbs. of freshly slaked lime to 3 gallons of water and applying it at the rate of ¼ to ½ gallon per hole. The mouth of the hole is then sealed to prevent the premature exit of its occupants.

(iii) The Chief Engineer, H.Q. R.A.F. Station Changi, reports that 1 lb. of slaked lime (two cigarette tinfuls) to 2 gallons of water (using a 2 gallons bucket) is effective. Six cigarette tinfuls of this mixture are poured down each hole and the top of the hole is then sealed with a clay plug.

(iv) The other methods outlined should be tried out on an experimental basis when possible.

(v) Positive efforts should be made to distinguish between burrowing and non-burrowing crustaceans. It is realised that engineers have little spare time to investigate the friendly or unfriendly activities of various types of crabs and lobsters, and until further information on the subject is available, the mud lobster (*Thalassina anamola*) may be regarded as the enemy, and the crab as a harmless crustacean in questionable surroundings. When casualties are being counted after toxic materials have been introduced into the burrows, the various species of crabs and lobsters killed should be identified as far as possible. It is unlikely that the offending lobster will be found unless the bund is cut away to the bottom of the burrow. A cessation of burrowing activity in the vicinity of holes recently treated may, however, reasonably be regarded as indicating that the treatment used has been effective.

A REVIEW OF FODDER GRASS INVESTIGATIONS, 1947 TO 1950

BY

G. S. KEEPING,

Agricultural Officer (Research).

Introduction.

One of the objects of the post-war policy of the Department of Agriculture has been the diversification of agriculture in Malaya, which involves an increase in the livestock population of the country. To feed this increased head of livestock more food will be required, and the most inexpensive form of food is grass. Investigations are being pursued in the establishment and management of grazing areas for livestock, but for intensive production fodder grasses, cut and fed, normally give a higher yield per acre than pasture grass.

Insufficient information was available post-war as to the manurial requirements of fodder grasses in Malaya, the best varieties, or their cultural requirements, and, as a result, the programme of fodder grass investigations was renewed in 1947.

Review of Pre-war Experiments.

The first manurial trial, laid down in 1932, was with Guinea grass (*Panicum maximum*). Eight manurial treatments were used as follows:—

1. Basic slag at 750 lbs. per acre.
2. Superphosphate of lime at 750 lbs. per acre.
3. Calcium cyanamide at 210 lbs. per acre.
   Basic slag at 750 lbs. per acre.
4. Sulphate of ammonia at 200 lbs. per acre.
   Superphosphate of lime at 750 lbs. per acre.
5. Calcium cyanamide at 210 lbs. per acre.
   Basic slag at 750 lbs. per acre.
   Sulphate of potash at 107 lbs. per acre.
6. Sulphate of ammonia at 200 lbs. per acre.
   Superphosphate of lime at 750 lbs. per acre.
   Sulphate of potash at 167 lbs. per acre.
7. Cattle manure at 4½ tons per acre.
8. Control — no manure.

Results over the initial period of 4 months showed that the heaviest yield was obtained from Treatment No. 6, being equivalent to 21 tons per acre per annum on heavy soil and 14 tons on light soil. These rates of maximum yield failed to be maintained, and were approximately halved over a subsequent period of one year.

The experiment was continued, with various modifications to lay-out and manurial treatments, after replanting in 1934, until December, 1937, and it was then concluded that, while phosphatic manures may be

useful initially in establishing an area of Guinea grass, the only way in which yields could be maintained at a reasonable level (i.e., 12 to 14 tons per acre per annum) was by manuring with 10 to 15 tons of cattle manure per acre per annum.

In 1938 and 1939 a further trial was laid down, with dressings of cattle manure ranging from 15 to 30 tons per acre. It was observed that a dressing of 30 tons per acre gave no increased yield over 15 tons per acre, and the conclusion was drawn that, on flat land of medium texture, the maximum yield of grass that could be obtained, with any manuring, was in the region of 16 tons of fresh cut grass per acre per annum.

Post-war Experiments.

After the war it was decided that a comprehensive series of trials would be laid down, covering manurial, cultural and varietal aspects of the subject. In all, six experiments have been laid down.

Manurial Trials.

(1) 3 x 3 x 3 MANURIAL TRIAL, GUINEA GRASS (F.E.S.S. 65).

This trial was designed to test the effect of N,P, & K on the yield of Guinea grass. The manures used were:—

Sulphate of ammonia.
Superphosphate.
Muriate of potash.

Each of these manures was applied at three levels, i.e., 0, 1, 2, at the following rates:—

Manures	Level and Weights of manures 0	1	2	
Sulphate of ammonia	0	2	4	cwts per acre per annum
Superphosphate	0	1½	3	„ „ „ „ „
Muriate of potash	0	1½	3	„ „ „ „ „

All possible combinations of these three manures at the three levels were used, resulting in 27 different treatments. Each treatment was then replicated twice, giving a total of 54 plots in the experiment.

The area chosen for the experiment had been under tea until mid-1948, when the tea was removed and the land cultivated. Between mid-1948 and August, 1949, a natural cover became established which was then ploughed in, and the land prepared for grass planting. Guinea grass was planted in September, 1949, with a planting distance of 2 x 2 ft. The first cut was taken in January, 1950, the experimental dressings of manure were applied immediately after the first cut, and recording commenced with the cutting in February, 1950. The annual dressings of manure were divided into four quarters, one quarter being applied every three months. The grass was cut at calendar monthly intervals, the weight of fresh grass being recorded. Plot size was 22 x 32 ft. but for harvest 2 ft. discards were allowed around the whole plot, thus giving a harvested plot size of 18 x 28 ft. or 0.0116 acre.

In October, 1950, a consolidated analysis of the results for the nine months period, February to October, 1950, was made. Table I shows these results under the various manurial combinations.

Table I.

Yield of Fresh Cut Grass (in lbs.). February to October, 1950.
Two-way Tables.

	N.0	N.1	N.2	Total
P.0	1,949	2,737	2,666	7,352
P.1	2,265	2,285	3,466	8,016
P.2	2,259	2,602	2,883	7,744
Total	6,473	7,624	9,015	23,112

	N.0	N.1	N.2	Total
K.0	1,820	1,991	2,109	5,920
K.1	2,360	2,659	3,140	8,159
K.2	2,293	2,974	3,766	9,033
Total	6,473	7,624	9,015	23,112

	P.0	P.1	P.2	Total
K.0	2,009	1,985	1,926	5,920
K.1	2,656	2,492	3,011	8,159
K.2	2,687	3,539	2,807	9,033
Total	7,352	8,016	7,744	23,112

The statistical analysis of the results showed a significant linear response to nitrogen (sig. at 0.1 per cent. point) and a significant linear response to potash (also sig. at the 0.1 per cent. point). There was no response to phosphate. The interaction between N & K, although large, was not significant, while none of the other first order interactions was of any importance. The best yield, that of the combination N_2K_2, was equal to a yield of 24 tons of fresh cut grass per acre for the 9 months period, or approximately 32 tons per acre per annum. The mean yield was at the rate of 16½ tons per acre, or approximately 22 tons per acre per annum.

The total yield of grass in February, 1950, i.e., the first cut after the first quarterly dressing of manure, was 4,463 lbs. The total yield in May, after the second application of manure, was 4,187 lbs., in August, after the third application, 1,090 lbs. and in November, after the fourth quarterly dressing, 2,987 lbs. The drop in the August weight was due to the very dry weather experienced in July and August. It is clear from these figures that, although there has been a drop in the monthly quantity of grass harvested between February and November, the drop is not as large as was recorded in pre-war experiments.

The experiment is to be continued for at least a further two years when it will be possible to assess whether the yield is maintained at its present level over a long period, and whether the same significant responses are obtained.

(2) Nitrogenous Manurial Trial, Guinea Grass. (F.E.S.S. 78).

As a result of experimentation in the United Kingdom it has been found that heavy dressings of nitrogenous manures give markedly increased yields of grass. It was therefore decided to lay down a further manurial trial at Serdang to test the effect on the yield of Guinea grass of massive dressings of nitrogen, in the form of sulphate of ammonia.

The area had been under tea until mid-1948 when the tea was removed and the land allowed to revert to light scrub. This scrub was ploughed-in in October, 1949, and the soil prepared for planting. Guinea grass was planted in November, 1949, with a spacing of 2 x 2 ft. Plot size was 16 x 50 ft. but this was reduced by 2 ft. discards around each plot to 12 x 46 ft. harvested, or 0.0127 acre. Table II shows the weight of manure per acre per annum applied to each of the six treatments.

Table II.

Guinea Grass Manurial Trial (F.E.S.S. 78).

Manurial Combinations.

Treatment	Sulphate of Ammonia (cwts. per acre per annum)	Rock Phosphate (cwts. per acre per annum)	Muriate of Potash (cwts. per acre per annum)
1	0	3	2
2	2		
3	4		
4	6		
5	8		
6	10		

As in the previous experiment, the annual manurial dressing was applied in four equal parts at quarterly intervals. The first of these was applied in December, 1949, and recording commenced on January 20th, 1950, weights of fresh grass in all cases being recorded. Table III shows the total weights of grass harvested from each treatment for the period 1st January to the 30th October, 1950.

Table III.

Weights of Fresh Cut Grass Harvested for Period 1st January to 30th October, 1950.

Treatment	Weight of Grass (lbs.)	Equivalent Yield (tons per acre)
1	2,495	14.6
2	3,070	18.0
3	3,437	20.2
4	3,640	21.4
5	3,845	22.6
6	4,228	24.8
* M.S.D. at 1 per cent.	398	—
M.S.D. at 5 per cent.	294	—

* M.S.D. = Minimum significant difference.

It is clear from Table III that for every cwt. of sulphate of ammonia applied to the grass, the yield is increased by approximately 1 ton per acre.

During the course of this experiment, the soil of the various plots was periodically tested for pH value and available calcium. There has so far been no evidence of any changes in these values due to fertiliser applications.

Analyses of the grass were not regularly made, but the results indicated that the protein content was not influenced by the rate of nitrogen manuring. Analysis will however be resumed.

(3) Time of Application of Manure Trial, Guinea Grass. (F.E.S.S. 67).

With the heavy rainfall experienced in Malaya, it was thought that a portion of any soluble artificial manures applied, such as sulphate of ammonia or muriate of potash, might very well be leached out of the soil before the grass could utilise it, especially if the manures were applied as annual or half-annual dressings. It was therefore decided to lay down a trial to test the effect, on the yield of cut grass, of applying a standard fertiliser dressing at varying time intervals. The manurial dressing consisted of:—

3 cwts. sulphate of ammonia per acre per annum.
2 cwts. superphosphate per acre per annum.
2 cwts. muriate of potash per acre per annum.

and treatments were as follows:—

Treatment A annual dressing applied in 12 parts, every 1 month.
„ B „ „ „ „ 6 „ „ 2 months.
„ C „ „ „ „ 3 „ „ 4 „
„ D „ „ „ „ 2 „ „ 6 „

The grass was planted in September, 1949, at a planting distance of 2 x 2 ft. The first of the manurial applications took place on 20th September, 1949, and the grass was cut on 19th October, 1949, after which manure, according to treatment, was applied and the grass cut at monthly intervals. Weights of freshly cut grass were recorded. Plot size was 14 x 20 ft., but this was reduced by 2 ft. discards around the plot to a harvested plot size of 10 x 16 ft. or 0.0037 acre. Yields at the end of the first year are shown in Table IV.

Table IV.

Manurial Trial, Guinea Grass (F.E.S.S.) 67)
Yield of Freshly Cut Grass for the Period 19th October, 1949, to 20th September, 1950.

Treatment	Weight of grass (lbs.)	Equivalent Yield (tons per acre per annum)
A	1,172	28.5
B	1,092	26.5
C	1,081	26.3
D	1,146	27.8

There were no significant differences between treatment totals. However, the monthly yields of grass from each treatment were plotted on a graph (see Appendix 'A') and from an examination of this graph it is clear that with Treatments C and D the great majority of the manure applied at any given point was utilized within 6 to 8 weeks of application, and little or none of it was leached. It is possible that with heavier dressings of manure the grass would be unable to utilize it all rapidly, and in that case leaching of the unused portion might occur. In the second year of the trial this effect will be tested.

(4) MANURIAL TRIAL. (F.E.S.S. 68).

This manurial trial is the "sub-treatment" portion of a large variety-manurial trial, but the manurial aspect will be considered first. The manurial treatments were as follows:—

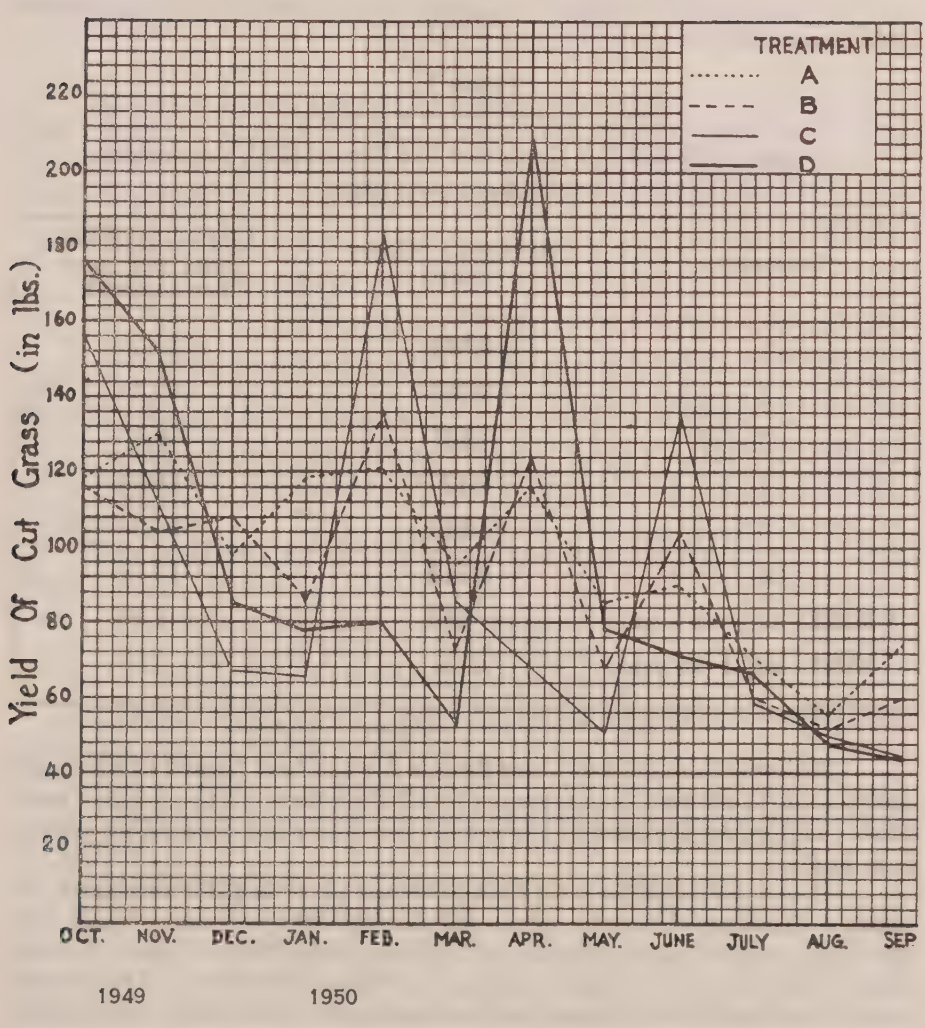
Treatment 1. Cattle manure at 5 tons per acre per annum.
„ 2. „ „ 10 „ „ „ „ „
„ 3. N.P.K. mixture at 3 cwts. „ „ „ „
„ 4. „ „ 6 „ „ „ „ „
„ 5. „ „ 12 „ „ „ „ „
„ 6. Cattle manure at 5 tons per acre per annum plus N.P.K. mixture at 3 cwts. „ „ „ „

Appendix 'A'

F. E. S. S. 67

FIRST YEAR OCT. 1949 — SEP. 1950

Yield of Cut Grass (In Lbs).



The N.P.K. mixture consisted of 3 parts sulphate of ammonia, 2 parts superphosphate and one part muriate of potash from 1st January to the 30th June, 1950, but was then modified to one part sulphate of ammonia and one part muriate of potash.

The experiment was planted in September, 1949, and the first quarterly manurial application (for artificials) and the whole annual dressing of cattle manure was applied on 30th January, 1950. Recording of weights of grass commenced on 23rd February, 1950. The harvested plot size was 22 x 24 ft. or 0.0121 acre.

The weights of freshly cut grass for the period 27th January to 28th December, 1950, are shown in Table V.

Table V.

Manurial Trial (F.E.S.S. 68)

Weight of Fresh Cut Grass for the Period 27th January to 28th December, 1950.

Treatment.	Weight of Grass (lbs.)	Equivalent Yield (tons per acre per annum)
1	5,989	13.3
2	7,011	15.5
3	7,231	16.0
4	8,120	18.0
5	11,243	24.9
6	8,442	18.7
* M.S.D. at 1 per cent.	885	1.96
M.S.D. at 0.1 per cent.	1,151	2.55

* M.S.D. = Minimum significant difference.

Statistical analysis of these figures for the first "year" of 48 weeks shows that Treatment 5 is superior to all the others at the 0.1 per cent. level. The other treatments yielded in the following descending order: 6, 4, 3, 2, 1.

It is interesting to note that, whereas there is little to choose between a dressing of 6 cwts. of an N.P.K. fertilizer and one of half this size plus 5 tons of cattle manure, yet the response from 10 tons of cattle manure was inferior to that from both these treatments. This would seem to indicate that a dressing of cattle manure is more efficient in combination with a complete fertilizer mixture than when applied alone.

Cultural Trials.

There are several cultural aspects in the growing of fodder grasses which need investigation. Insufficient information was available before

the war on such aspects as intervals between cuttings, planting distances, and the effect of inter-row cultivation. Only one cultural trial has been laid down since the war, and this was concerned with the intervals between cuttings of Guinea grass.

INTERVALS BETWEEN CUTTINGS TRIAL, GUINEA GRASS. (F.E.S.S. 78).

This experiment was run in conjunction with the nitrogenous manurial trial already mentioned; a split plot layout was adopted, the subplot size being 46 x 4 ft. or 0.0042 acre. Three intervals of cutting were used, namely:—

Treatment A. Cutting the grass at intervals of 3 weeks,
„ B. „ „ „ „ „ „ 6 „ and
„ C. „ „ „ „ „ „ 9 „

The experiment ran for 18 weeks, after which it was concluded since it was obvious that the yield of grass from the plots cut at intervals of 3 weeks was falling rapidly and the grass from these plots was in danger of dying out. At this stage treatment yields, in lbs. of freshly cut grass, were:—

Treatment A 2237 lbs. or 6.6 tons per acre.
„ B 3154 „ „ 9.3 „ „ „
„ C 4060 „ „ 11.9 „ „ „

Although the yield of grass from the plots cut at intervals of 9 weeks was very much higher than from those cut at intervals of 3 or 6 weeks the grass itself was inclined to be tough and unpalatable, and it was concluded that the optimum interval for cutting Guinea grass was about 6 weeks, at which stage the grass, while yielding well, is palatable.

Variety Trials.

Three fodder grass varieties have been tested since the war. These are:—

Guinea grass (*Panicum maximum*)
Guatemala grass (*Tripsacum laxum*)
Napier grass (*Pennisetum purpureum*)

Of these three grasses, Guinea grass appears to be the most and Guatemala grass the least palatable.

VARIETY TRIAL. (F.E.S.S. 68).

This trial consisted of the main plots of the manurial trial already mentioned.

There were three main treatments as follows:—

A. Guinea grass.
B. Guatemala grass.
C. Napier grass.

In the case of Guinea grass and Napier grass, the planting distance was 2 x 2 ft. but with Guatemala grass planting distance was 3 x 2 ft. Harvested plot size was 132 x 24 ft. or 0.073 acre.

The weights of freshly cut grass for the three varieties during the period 27th January to 28th December, 1950, are shown in Table VI.

Table VI.

Weight of Fresh Cut Grass for the Period 27th January to 28th December, 1950.

Treatment	Weight of Grass (lbs.)	Equivalent Yield (tons per acre per annum)
A	13,882	15.4
B	16,546	18.3
C	17,608	19.5
* M.S.D. at 0.1 per cent.	2,594	—

* M.S.D. = Minimum significant difference.

The statistical analysis of these figures shows Napier and Guatemala grasses to be significantly better than Guinea grass at the 0.1 per cent. point. Actual yields are low, although the reason for this is not clear.

Discussion.

Manurial Treatments.

None of the experiments has been running for a sufficiently long period to enable firm conclusions to be drawn from the results. Interesting figures have, none-the-less been obtained and results should become progressively more interesting as the experiments continue. The 3 x 3 x 3 factorial experiment has already demonstrated that, on this particular soil type, both nitrogen and potash cause a marked increase in the yield of Guinea grass, and that phosphate, in the form of superphosphate, gives no yield response at all. Phosphate does however hasten the flowering of the grass, which is an undesirable feature. Lack of potash causes a typical "burning" of the leaves of the grass, and this effect is enhanced when nitrogen is added without potash. Grass receiving both nitrogen and potash is a deep green, healthy colour. Furthermore, over a period of nine months, yields have been maintained at a satisfactory level without the use of any cattle manure whatsoever, and with moderate dressings of artificial manure only.

The experiment with increasing rates of nitrogenous manure demonstrates that, even with dressings of as high as 10 cwts. sulphate of ammonia per acre per annum, the level at which heavier dressings do not give a significant increase in yield has not been reached. These heavy dressings of nitrogen are in conjunction with a small dressing of potash only, and it is possible that the response to nitrogen would be considerably increased with a higher level of potash manuring. From the results of the experiment it would appear that 1 cwt. of sulphate of ammonia gives an increase in yield of rather more than 1 ton of grass per acre per annum. At least in the first eight months of growth, 10 tons of cattle manure per acre per annum gives no better yields than 3 cwts. N.P.K. mixture

per acre per annum, and the yield is inferior to 6 cwts. of N.P.K. mixture. A combination of 5 tons of cattle manure plus 3 cwts. of N.P.K. mixture, however, gives similar yields to 6 cwts. of N.P.K. This result is of some importance since, if it is sustained in the second and third year of the experiment, it will provide a key to cheap and efficient manuring.

Varieties and cultural aspects.

Experimentation has shown that, as far as bulk is concerned, Napier grass gives a higher yield than Guinea grass and, if cut at intervals of 6 weeks, the grass appears to be palatable and is eaten freely by cattle. Goats, however, do not eat Napier grass freely, preferring Guinea grass, and it is likely that this latter grass would be more suitable for the production of dried grass. Guatemala grass is coarse, although cattle eat it freely, but under normal, dry land conditions its yield does appear to justify its being grown in place of Guinea grass.

It has been shown that cutting at intervals of 3 weeks is too severe for Guinea grass, and that probably an interval of 5 or 6 weeks would give the best results. No investigations have yet been carried out to ascertain the optimum interval of cutting for Napier or Guatemala grass, or the optimum height of cutting.

Conclusions.

The majority of the experiments discussed have been running for a year, or less, and no hard and fast conclusions can therefore be drawn. It appears probable, however, that fodder grasses can be grown successfully in Malaya, at least for short periods, with applications of artificial manures only. A combination of cattle manure and artificials appears to be a highly effective mixture and practicable for the small farmer. It appears that yields of Guinea grass obtained in pre-war years at the Federal Experiment Station, Serdang, were unusually low, and that yields in the order of 30 tons freshly cut grass per acre per annum should not be difficult to achieve. A possible reason for the poor yields of Guinea grass before the war, even with manuring, lies in the fact that no mechanical inter-row cultivations were carried out, whereas all post-war experiments have been regularly inter-cultivated. It would be unwise to draw further conclusions at this stage.

Summary.

A number of manurial, cultural and variety trials started at Serdang after the war are discussed. It is shown that Nitrogen and Potash give significant increases in the yield of grass, but that Phosphate does not do so. Increasing dressings of Nitrogen of up to 10 cwts. sulphate of ammonia per acre per annum give linear increases in yield, and it is likely that optimum dressings have not yet been reached. Napier and Guatemala grasses appear to be the heaviest yielding varieties, although Guinea grass is more palatable for certain types of stock. Intervals of cutting of fodder grasses are discussed, and the conclusion drawn that, for Guinea grass, intervals of 3 weeks are too short.

THE SUPPLY OF PLANTING MATERIAL TO RUBBER SMALLHOLDERS

BY

R. G. HEATH,

Chief Field Officer.

In August 1949, the Secretary of State for the Colonies made available a grant of £121,786 ($1,043,880) from the Malayan allocation of the Colonial Development and Welfare Fund for a scheme to provide approved rubber planting material for smallholders.

Whatever the future of the rubber planting industry may be, there is an economic necessity for encouraging the planting of high-yielding material, in which Malaya is considerably behind neighbouring territories, particularly Indonesia. This is all the more important because of the increasing competition of synthetic rubber and between natural rubber producing countries. The necessity for replacing old stands with trees of improved stock is fully appreciated by the large estates, most of which have been pursuing, for some years now, a policy of replanting and can, in the majority of cases, find the necessary finance. The smallholders' position, on the other hand, is less satisfactory. The total acreage of smallholdings, i.e. holdings of under 100 acres, is 1,400,000 acres, which is 42 per cent. of the acreage under rubber in Malaya. Of this large area, over 90 per cent. of the trees are over 25 years old and are either uneconomic or will become so in the not far distant future. Should this be allowed to happen, the result would be a loss both to smallholders and to Malaya as a competitor in the world market. Nor has the smallholder, if unassisted, the same facilities for obtaining improved planting material as the large estate. It is therefore necessary to assist him to maintain and improve his position as a rubber producer.

An express condition of title is now being imposed on all land alienated for rubber that it must be planted with approved planting material. The scheme, which is the subject of this article, aims at supplying that material and, further, in instructing the smallholder in the correct use and husbandry of that material.

A scheme was started before the war, whereby budwood nurseries were established on a number of Agricultural Stations throughout the country and on the Rubber Research Institute Experiment Station at Sungei Buloh. The finance to develop these areas was provided by Government through the Department of Agriculture, and the actual work was done by the Department of Agriculture and the Rubber Research Institute in co-operation. The present scheme is in continuation of this earlier one and involves the re-establishment and considerable expansion of the nursery areas. In the existing financial position of the Federation of Malaya, however, it is not possible to provide the funds necessary to carry out

this programme, important though it is for the economic future of the smallholder in the rubber industry. Accordingly, application was made to the Secretary of State for the Colonies for assistance.

The present scheme, which is likewise being operated by the Department of Agriculture and Rubber Research Institute in co-operation, provides for an annual programme of new planting plus re-planting of 50,000 acres, thus replacing about 250,000 acres of senescent smallholding rubber in a five years' period. The ultimate aim is to replace 500,000 acres over a ten-year period but, as it is difficult to visualise the annual requirements of planting material so far ahead, it has been considered wiser to limit the scheme in the first instance to an initial period of five years. It is proposed at the end of this period to review and, if necessary, revise the programme for the second five-year period in the light of experience gained.

The scheme is now well under way and is being operated in four sections, consisting of (a) budwood multiplication nurseries, (b) clonal seedling nurseries, (c) the provision of technical assistance and (d) provision for future supplies of planting material.

Of the budwood multiplication nurseries, 90 acres of new nurseries will be established during the initial five-year period of the scheme mentioned above, while 60 acres of existing nurseries are being renovated and maintained. The existing nurseries, which are located throughout the country in relation to smallholding areas, are all operated by the Department of Agriculture while 75 and 15 acres of new nurseries are being laid down by the Rubber Research Institute and the Department of Agriculture respectively.

Of the clonal seedling nurseries, 62½ acres annually are being laid down, 37½ acres by the Rubber Research Institute and 25 acres by the Department of Agriculture.

The provision of technical assistance involves the training at the Rubber Research Institute Experiment Station at Sungei Buloh, of batches of selected youths from smallholding rubber areas, for six-months periods, in all aspects of rubber cultivation, with special emphasis on the art of budding, with the object of their forming a nucleus of instructed individuals in the areas concerned who can both undertake the work of budding and impart their knowledge to others.

The provision of future supplies of planting material involves the establishment of 200 acres of clonal seed garden at Sungei Buloh by hedge-plantings of the best parent clones, the area between the hedges being planted with budwood or clonal seedling nurseries or utilised for experiments on two-crop cultivation such as interplanting rubber with cacao.

As stated above, the scheme is based on an estimated demand for material to plant 50,000 acres each year, but the extent of the demand cannot accurately be foreseen and is dependent on factors, the consideration of which falls outside the subject of this article. The propagation and distribution of improved material will, however, be adjusted over the period, as near as possible to be in keeping with the demand.

The clonal planting material is being supplied to the smallholder at a subsidised cost; he pays 10 cents a yard for budwood and 4 cents per stump for clonal seedling stumps, the price charged for clonal seedling stumps being equated to the cost of establishing budgrafted trees including the price of budwood, the cost of the labour of budding and after care.

When presented for the first time, as in this scheme, with two types of improved planting material, the smallholder is showing a marked preference for using clonal seedling stumps as opposed to budwood. This is not surprising as the planting of clonal seedling stumps involves less time, skill and trouble as compared with the budding operation. Thus it is probable that, in view of this preference, the scheme will need some revision in the form of an increase in the existing proportion of clonal seedling to budwood nurseries. The possibilities in this direction are limited, however, as the establishment of clonal seedling nurseries is an annual operation and involves both additional land and labour whereas budwood nurseries once established, are available for several years.

From the inception of the scheme in the latter half of 1949 to the end of 1950, the following quantities of materials have been distributed to smallholders from the various centres:—

Budwood—37,176 yards

Clonal seedling stumps—1,123,278.

These quantities represent an approximate figure of 7,000 acres of replanting and new planting or 14 per cent. of the annual target of 50,000 acres. There are two factors affecting the position. There is the basic one, as far as replanting is concerned, that the smallholder has to face a loss of income during the period of six years when there is no crop, and the secondary one arising from the very high price which has been paid for rubber since the middle of 1950; the latter has encouraged the smallholder to retain his existing trees, however obsolescent.

Two courses have been held at Sungei Buloh under the technical assistance section of the scheme but these have been confined in such case to 10 trainees. The full complement of 50 trainees per course cannot be accomodated until the quarters under erection have been completed, it is hoped by May, 1951.

A NEW COCONUT PEST IN SINGAPORE

BY

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Acting Senior Entomologist.

Introduction.

During a brief visit to Singapore early in April, 1951, the writer noticed damage to leaves of some young coconut palms in the Meyer Road area. Examination of fronds showed two types of damage characteristic of Hispid leaf-beetles, and specimens of a reddish-brown beetle of this family were found. This proved on subsequent examination in Kuala Lumpur to be the Philippine leaf-miner, *Promecotheca cumingi* Baly, a very serious coconut pest in the Philippines.

The Coconut Leaf-Mining Beetle.

Distribution.

Although *Promecotheca cumingi* is not a Malayan insect, it made its appearance in the Town area of Malacca and in the suburban districts of Tanjong Kling and Pangkalan Balak in July, 1917, but failed to become established (1) and no authentic mention has since been made of its appearance in Malaya except for erroneous records by Dammerman (2) and Maulik (2a). The then Assistant Entomologist (Mr. B. A. R. Gater) visited Labuan, British North Borneo, in 1924 to study coconut insects but did not record *Promecotheca* there (3), though he referred to it as being common there the next year (4).

The recent establishment of this insect in Singapore seems to have taken place between October and December, 1949, having probably arrived by air on plant material from the Philippines some 18 months before its presence was first noticed in the Colony.

Description.

The beetle is reddish-brown in colour, the wing-cases have a series of linearly arranged pits and its overall length is approximately one-third of an inch. Damage by the adults consists of gnawing a series of fine grooves on the lower surface of the leaflets. The portion eaten is the spongy tissue up to, but not extending through, the waxy upper surface. Most damage is done near the leaf tips. Severe attack results in the leaf tips shrivelling into brownish-grey tissue which curls downwards so as to give a characteristic appearance noticeable to the naked eye even in tall palms.

The eggs are laid in the lower, rougher surface of the leaflets and are covered with fragments of chewed leaf tissue so that one sees an oval, chaff-coloured, raised area about one-tenth of an inch in length. The female beetle normally lays her eggs nearer the base of the leaflet and the young larva usually mines, therefore, towards the leaf tip. The incubation period was found, in July and August, 1951, in Kuala Lumpur, to be from 13 to 15 days and this figure was given by Jones in 1913 (5)

in the Philippines. Corbett mentions (6) "about 3 to 5 days" which is far too short a hatching period for eggs of any species of *Promecotheca* though usual in the allied genus *Brontispa*.

The larva is a flattened, legless, yellow grub measuring about one-twentieth of an inch in length when hatched. The first segment consists of a brownish, chitinous plate above and below enclosing the small head so that only the dark-brown mouth-parts are visible. As the larva develops, the rest of the body increases in size relative to the thorax which comprises a very large portion of the total length in the early stages. When full grown the larva measures two-fifths of an inch, tapering gradually from the second segment. Its whole life is spent within the mine, which increases in length from about one-tenth of an inch up to 8 ins. and is eaten so that its excavated part is nearer the upper leaf surface.

As already described for the beetle, the tissue eaten is the central spongy portion but in the case of the larva an unconsumed thickness is left on the lower surface of the leaflet which, as the larva tunnels with its upper surface ("back") facing downwards, forms the roof of the mine, As was first recorded by Jones (5), the larva deposits its droppings in a row on each edge of the mine; those seen by the writer were in small groups forming an interrupted chain-like track. The damage by the larva is to the central portion of the leaflets between the basal part, where the eggs are laid, and the tips already dried up as a result of feeding by the adults. Heavy rainfall can soak through into the mine and kill the developing larva which takes four weeks to mature.

It was noticed that some larvae, having mined for several inches, may retrace their course towards the site where the egg was laid and make another mine running in the opposite direction.

As was recorded by Taylor in his monograph (7) on the closely related Fijian species *P. reichei* Baly, each mine shows two distinct lines marking the position reached by the first, second and third instars (stages) of the larva. With *P. cumingi* there is a greater tendency to feed towards the wider part of the leaflets nearer the mid-rib.

The pupa is orange-coloured with two rows of short spines on the upper surface of each segment, and the skin is wrinkled but otherwise shiny. Jones (5) says it is "covered with hairs", but this does not hold for local pupae examined by the writer, or for two other species of *Promecotheca* found in coconut palms in the islands of the Pacific. Its length is three-eighths of an inch; development has not yet been worked out but is said to be from 5 to 12 days in the Philippines—a relatively long range. The eyes darken before the wing cases.

As with the larva, the whole pupal period is passed within the mine and as the relative position of the egg and larva is unchanged, the future legs lie towards the upper surface of the leaf, the floor of the mine being a thin skin through which the beetle finally gnaws a hole. It is through this thin surface that parasites attack the developing larvae and/or pupae. The total cycle takes 7½ to 8 weeks.

Other Food Plants.

Additional food plants found by the writer in June were areca, oil palm and royal palms; the damage to all these was much less severe than to coconut. Burkill (1) recorded nipah and sago palms as scarce hosts in Malacca in 1917: the insertion of the incorrect botanical name *Caryota urens* for the latter palm instead of *Metroxylon* in the *Review of Applied Entomology* (8) has resulted in this record being perpetuated up to 1947, as Lepesme's recent book (9) gives *Caryota* as a host plant, presumably from this source.

Parasites.

Four Hymenopterous parasites were bred out in Kuala Lumpur in July from collections of young stages made in June. These comprise a minute egg parasite, *Ooencyrtus* sp. which is very scarce and of negligible importance; a larger (1/25 in.) black, larval parasite (*Pleurotropis parvulus* Ferr.) with white tarsal leg joints, which is the commonest and most efficient parasite; another larval parasite or hyperparasite *Dimmockia* sp. with a white abdominal band and compound antennae in the male and a still larger Eupelmid parasite, with a metallic green abdomen. This *Pleurotropis* is the same species which was introduced in 1933 by Taylor and Paine from Java into Fiji where it effectively controlled a closely related *Promecotheca* in the coconut plantations. It appears from the apparent failure of the Philippine beetle to spread in Singapore (see below) that it may be already under biological control from this small wasp-like parasite. It is interesting to find that in such an urban area as Sims Avenue no less than four parasites should have searched out and attacked this introduced beetle in the tops of the palms. None of these parasites had been previously recorded from Malaya, though they are clearly local species.*

Distribution in Singapore.

During April and May, 1951, the staff of the Department of Agriculture, Singapore, mapped the approximate distribution of this beetle which then extended from the Geylang Road/Mountbatten Road junction in the west, and south of Macpherson Road/Paya Lebar Road junction to Still Road in the east.

The writer visited Singapore in the last week of June and it was found that there had been an extension in the Kallang area up to Macpherson Road, up Jalan Eunos and eastwards as far as Telok Kurau Road. The worst section was the Sims Avenue/Aljunied Road, a fairly densely populated area with small gardens each with only a few coconut palms. The bulk of this mapping was done by Che Baharun bin Haji Ishan with assistance from the Agricultural Officer, Singapore, and it was carried out more intensively than the April/May searches. A considerable number of infected leaves was collected.

In August, there was a very slight extension in the north-west involving the Serangoon Road crossroads and just north of Macpherson

* Some of the eggs collected in August were parasitised by *Achrysocharis promecothecae* Ferr., making a total of five parasites.

Road but a regression of the eastern limit at Telok Kurau Road, and it is hoped that this denotes a definite check as a result of the parasite *Pleurotropis parvulus*. The Sims Avenue/Aljunied Road area was still the worst affected. This survey was carried out by Che Abdul Majid bin Tahir who again was assisted by the local Agricultural staff.

Climatic Influence.

In an attempt to account for the failure, already mentioned, of this beetle to establish itself in Malacca 34 years ago, the figures for average rainfall for ten years (1930 to 1939) were kindly supplied by the Director of the Malayan Meteorological Service. Comparisons of these monthly averages, taken at Bukit China, Malacca, with the rainfall recorded (10) from August to December, 1917, at nearby Durian Daun showed that just over 4 more inches (44.43 and 48.66 ins.) fell in these five months of that year. However, the month of August, 1917, had a total of 14.48 ins. as against a 10 year average of only 7.51 ins. and it is probable that this heavy rainfall, plus an attack by parasites, could have caused a set-back to the beetle by drowning many larvae in their mines. It is, of course, not actually known for how long the pest had been present before it was first noticed in July, 1917. Taking Dobby's rainfall figures (11), Singapore has an average annual rainfall of 95.2 ins. compared with 82.2 ins. for Manila so that, climatically, Singapore can be expected to be suitable for this introduced beetle.

Summary and Conclusion.

The Philippine leaf beetle *Promecotheca cumingi* Baly was introduced into Singapore, probably by air in 1949, and when first noticed in April, 1951, was attacking coconuts in the south-east portion of the island. Its spread appeared to be checked by August and it is hoped that the indigenous larval parasite *Pleurotropis parvulus* Ferr. will continue to keep it under control, as insecticidal treatment would be both difficult and expensive.

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MECHANIZATION

Quarterly Progress Report, January to March, 1951.

Compiled by the Acting Senior Agricultural Officer (Research) and the Agricultural Officer (Engineering).

Recent Importations.

The following implement was received during the period under review:—

Ransome "Magic" reversible disc-plough, model D.5.

Tests and Modifications.

The Gem Rotary Hoe with Large Diameter Wheels.

Another trial has been conducted, in Province Wellesley, with the modified rotary hoe which was mentioned in the July, 1950 issue of this journal. It was once again shown that good work could only be done when a pan existed near the surface and that, where such conditions exist, the standard Gem Rotary Hoe does quite satisfactory work.

The Weedmaster Direct-Mounted Low-Volume Sprayer.

This sprayer has been modified for spraying *lalang* (*Imperata cylindrica*) with a water-aromatic oil emulsion. Satisfactory agitation of the emulsion was achieved by returning part of the pump output to the tank through a pair of submerged nozzles. The second modification found necessary was to replace the spray booms of low-volume, tee-jet nozzles by an adjustable hand lance. This proved most satisfactory in use but the average labourer had difficulty in keeping up with the output of the machine. It will probably be feasible to fit a second hand lance to this sprayer.

Ferguson TE-D. 20 Kerosene Tractor.

Tests with this tractor are now in progress, in Malacca, using an improved technique whereby the fuel consumed during the test is measured very accurately and the working time is recorded both by a Servis recorder and by stop-watch measurement. By this means it is hoped that future departmental tests will be carried out with increased accuracy.

Investigations into Wet Padi Cultivation.

Threshing Trials.

Two interesting threshing trials have been carried out recently in Perak and Province Wellesley. In the first, the Robinson's Midget Thresher was tested at Titi Serong, in the Krian district of Perak, and cultivators were impressed with the comparative cleanliness of the threshed grain and by the working speed and simplicity of the thresher. This is a small machine with a 27 ins. peg-drum and about 36 sq. ins. of separating area. In the test it was driven off the belt-drive of a Fordson Major tractor. The chief practical difficulties were those associated with shortage of labour for carrying the cut padi from the field to the thresher. In some cases this led to the inevitable suncracks which develop in any

grain exposed to alternate rain-wetting and sun-drying. Nevertheless the results from this trial were of sufficient promise to justify more extensive trials next season.

The second threshing trial was with a combine-harvester at Bukit Merah, Province Wellesley, where a McCormick Deering 52R machine was used. This trial was instructive if somewhat unsuccessful. A field, 7 acres in area, of padi had been set aside for the test and water was drained off 1 month before maturity. The land dried out well and soil cracks developed and would undoubtedly have supported the harvester and track-tractor (I.H.—T.D.6). However, rain fell for several days before harvesting and culminated in a storm the night before. By this time, grain ripeness permitted no delay and, when work started, the combine bogged down so frequently that the trial was abandoned after 5 hours. The Settlement Agricultural Officer, Penang & Province Wellesley, who conducted the trial, concluded that complete mechanization of wet padi cultivation would always be speculative wherever irrigation depends on raising the water level of the soil from the bottom upwards, as opposed to surface irrigation with the sub-soil remaining unsaturated.

A later trial at Bukit Merah proved more satisfactory when a plot of just under 1½ acres of the non-shattering variety *Mayang Sa'batil* was combine-harvested in 4 hours without difficulty, except for a few minor drum-blockages. Performance details of this trial, together with those obtained from the Krian threshing trials, are given in Table I.

The actual yield in the *Mayang Sa'batil* plot was estimated at 390 gantangs per acre by a hand cutting test. The difference between this and the combine-harvested yield was, therefore, 78 gantangs per acre but this estimate would be subject to an experimental error of unknown magnitude. This difference was probably due to the following causes:—

(1) Loss at the cutter bar or out of the special trap-tray.

(2) Under-ripe grain left in the straw.

(3) Losses on headlands, which are inevitable where a combine-harvester is used.

The slow working speed was caused by a thick straw crop which required driving in first gear at a low throttle-setting. Any attempt to move faster resulted in straw being fed into the combine-harvester faster than the drum could handle it.

Table I.

Threshing Trial with a Combine-Harvester
Performance Details.

	Hand Reaping and Threshing.	Hand Reaping and Mechanical Threshing.	Combine-Harvested.
Yield per acre	314 gantangs	314 gantangs	312 gantangs
„ „ „	1,790 lbs.	1,790 lbs.	1,778 lbs.
Details of labour: *			
Reaping	320 woman hours	320 woman hours	2.8 driver hours
Threshing	120 man hours	3 driver hours	5.6 man hours
Winnowing	38 man hours	15 man hours	
Total per acre	478 man/woman hours	338 man/woman hours	8.4 man hours
Cost per acre:			
Labour	$116.24	$ 78.58	$ 3.79
Fuel	—	6.04	4.87
Depreciation	—	2.28	8.28
Maintenance and supervision	—	5.00	15.00
Total	$116.24	91.90	31.94
Cost per gantang threshed grain	$ 0.37	$ 0.29	$ 0.10

* Labour cost based on the following rates of pay (including cost of living allowance):—

Tractor Driver 1 — $5.16 per 6½ hours day.
Labourers (Male) — $2.24 „ 8 „ „
„ (Female) — $1.80 „ 8 „ „

NOTES ON CURRENT INVESTIGATIONS, JANUARY TO MARCH, 1951.

Compiled by the Acting Chief Research Officer and the Acting Senior Agricultural Officer (Research).

Padi.

Selection on the varieties Nachin and Serendah Kuning is approaching the final stages and proved strains should be available for distribution within the next three years. A trial of 20 strains of Serendah Kuning at Jasin, Malacca, gave ambiguous results which may have been influenced by numerous adverse conditions during growth. Trials of Nachin strains, also at stations in Malacca, were affected by serious damage from *Leptocorisa* but were otherwise more in accordance with expectations. Study of the results of variety trials in the 1947-50 period shows that at least three seasons' results are required before conclusions can be drawn regarding varietal behaviour. There is marked interaction between season and variety yield. Initial attempts at hybridisation had very small success but improvement in technique is being made. The serious depression in yield consequential on transplanting padi seedlings when over-age is clearly revealed in the results of three years experiments, and a fuller report will be published later.

Some of the results of manurial experiments in the 1950-51 season have been received and statistical analysis is in progress. Very marked responses to fertiliser applications in Kelantan experiments have been obtained, but the majority of west coast trials have given inconclusive results. The preliminary conclusion reached from the Kelantan results is that wet padi requires available nitrogen and phosphorus which will probably be supplied most economically by ammonium sulphate and superphosphate.

West coast trials have given indications that broadcasting rock phosphate is more effective than placement beneath the surface, and that where ammonium sulphate has depressed yields, sodium nitrate has been more beneficial. These observations still await confirmation.

In combined manurial and variety trials in Kelantan there were no signs of differential responses of varieties. Dry padi in Kelantan responds readily to fertilisers and the depth of application is not important. Deep cultivation appears to be beneficial when not performed too early.

A seeding trial at Bukit Merah, Province Wellesley, in which the seed was broadcast by hand or fiddle on flooded land, yielded an average crop of approximately 300 gantangs per acre. Operation from a tractor was unsatisfactory, but as the seeding could be done on foot by fiddle broadcasting at the rate of 3 acres per hour, the method has good prospects where water control is good.

On an experimental plot of padi at Kuala Sungei Bahru, Malacca, Agrocide 3 dust was applied by a portable power duster for trial against

Leptocorisa acuta. The atmospheric conditions were not entirely suitable, and only a temporary check was caused. These bugs were swarming in the surrounding area and required a much larger scale attack.

In connection with the deposition of iron oxide on roots and sheaths of padi plants, which is associated with the disease locally called *penyakit merah*, rice seedlings grew well in small pots irrigated with water containing 0.5 or 1 per cent. of ferric chloride and did not exhibit any deposition of iron.

Cacao.

Legitimate seedlings produced by crossing or selfing the best selected Trinitario trees already known to exist in Malaya are undergoing further culling, and the progenies finally chosen will soon be planted in the field prepared for them . Recording at Temerloh, Pahang, has shown that the plot contains few if any trees worthy of propagation. A private estate block planted from post-war seed importation is expected to have a few trees of interest.

Illegitimate progenies of kampong Criollo are growing well, but the progress of budding Criollo on to Trinitario stocks has remained unsatisfactory.

The budding of Amelonado on to Trinitario stocks has been successful, and about 600 budded plants are established in a nursery as a source of Amelonado budwood and cuttings. Attempts to bud Amelonado on Trinitario seedlings in baskets had a very small degree of success. Subsequently, however, a successful technique was evolved which has since given good results.

The open-air spray propagator for striking cuttings is in use, and the technique is being studied. Results have been variable and sometimes good; variations in conditions have been tried.

Further importations have been made of seed from Trinitario selections, and seedlings successfully raised in Pulau Tekong isolation nursery. Most of the improvements planned for the efficiency and convenience of the isolation nursery have been completed.

Continued observations in various localities indicate that the establishment of cacao in jungle or old secondary jungle is likely to be more successful and economical than planting on cleared land. Wild pig has so far been a source of damage and only time can tell whether monkeys and squirrels will be serious pests when pods are produced.

Erythrina subumbrans, a thornless *dedap*, promises to be a very useful secondary shade, for it can be established from large cuttings like *Gliricidia maculata* and makes more rapid growth than the latter. There was a severe attack on *Parkia javanica*, used for tertiary shade of cacao at Ayer Itam Agricultural Station, Penang, by lepidopterous larvae boring in the branches and shoots. Three species of these insects were involved, and with associated parasites are being further studied. The larvae eventually disappeared from the trees, which appear to be recovering.

Fermentation of Trinitario beans was much more successful in respect of flavour when some 300 pods were available, and the process

was conducted in a large basket, than when beans from a few pods were previously fermented in laboratory apparatus.

Oil Palms.

Recording has continued on selected palms and a summary of the records for the past five years is being studied. Breeding has continued with controlled pollinations. Two previous pollinations of dumpy palms with *pisifera* pollen from Nigeria have resulted in fruit bunches which are now approaching maturity. Legitimate dumpy oil palm seedlings have been distributed to the number of over 10,000 during the quarter. Much important pedigree material remains in the nursery at Serdang awaiting the acquisition of new land for planting.

In conjunction with field selection and recording at Serdang, laboratory determinations of oil content of fruit were made. The composition of the ash of the leaves of three families of palms previously manured has not appreciably altered during the quarter although the appearance of the palms has improved. The first experiment of growing oil palm seedlings in nutrient solutions of different composition was terminated and the plants are being analysed. A second experiment using a more suitable make-up of nutrients has been started. In an observation of the effect of aluminium it was found that in the particular nutrient mixture, not more than 0.16 gramme per litre of aluminium sulphate could be added without being precipitated as phosphate. This amount of soluble aluminium had no ill effect whatever on the plants as far as could be observed. Higher concentrations of aluminium are now being applied by the device of alternately placing the roots in nutrient solution and in solutions of aluminium sulphate in tap water.

A case was investigated where young oil palms growing on peat were affected by rotting of the central shoot, in which only a saprophytic fungus was found. The outer leaves were healthy, but examination of the root system showed that although the outer roots were well developed, the central roots had not penetrated a hard ball of quartzite soil with which the seedlings had been lifted from the nursery.

An experiment on the manuring of oil palms at Serdang with rock phosphate by broadcasting and by placing in pockets has not indicated any difference between the two treatment yields, but the experimental error is extremely high.

Coconuts.

Further cases of basal stem rot of coconuts due to *Ganoderma lucidum* have been examined. Arrangements are being made for observation of soil water movement in drainage experiments on the coconuts on heavy clay at Port Swettenham.

Fibres.

Planting material of Mauritius hemp has been raised for an experiment on the effect of shade.

Jute spacing trials are in progress where the crop is being grown on padi land in the off-season.

An attempt is being made to improve the poor yields of the Manila hemp variety trial at Serdang by applying several measures of soil amendment. Suspicions have been entertained of the existence of chronic bunchy top disease on Manila hemp at Serdang. Suckers from a backward stool representative of the condition have been planted in a light well drained soil supplied with compost, and it is found that the new growth is normal, with no symptoms of virus. Transmission tests by aphid vectors will be made when Manila hemp seedlings have been raised from seed.

Tea.

The rooting trial of cuttings from selected bushes is continuing at Serdang. Two manurial trials are now in progress at Cameron Highlands. A more permanent increase in the copper content of tea leaf on a group of bushes at Serdang has been achieved as a result of doubling the concentration of copper sulphate solution applied to the soil at the roots. It is proposed to carry out comparative fermentation of such leaf and leaf from untreated bushes.

Investigations of blister blight at Cameron Highlands are being actively pursued, but dry weather, in bringing a welcome fall in incidence for the planters, has given less scope for study of the disease. Spraying experiments which have continued since last June have given striking testimony of the importance of protecting pruned bushes against blister blight. The sprayed plots have ample foliage in contrast to the unsprayed plots where the bushes have made hardly any growth. Appearances of blister blight on lowland estates in spells of damp weather are not expected to have severe effects.

Fodders.

Stylosanthes gracilis, which at first grew well but failed to flower, and had to be propagated by cuttings, is now flowering and seeding both in Kedah and Kelantan. The Malaysian species *Stylosanthes sundaica* has been established in Kuala Lumpur. Also in Kuala Lumpur, there has been established a plot of the so-called Thornless Mimosa of Ceylon, *Aeschynomene Americana*. L.

Pastures.

Several grazing areas at Serdang are being improved by drainage and preparations are being made for a pasture manurial trial by taking pre-treatment yields on the proposed site.

Pineapples.

In a manurial trial which has been proceeding on a private pineapple plantation on peat in Johore, there has been an interesting result in that application of potassium chloride at the rate of 2 cwts. per acre has given the greatest response and is superior to a complete NPK dressing incorporating the same amount of potash. On the same plantation, a spacing trial has been laid down to compare four different systems of planting.

Miscellaneous Crops.

Three variety trials at Kuala Lumpur have given significant yield differences. In the first, Mauritius Mignonette lettuce was superior to Australian Mignonette; in the second, Kinta brinjal was superior to Batu Gajah and Local S while the Mauritius variety was destroyed by slime disease; in the third, Chinese long bean was superior to the local and to a Mauritius variety. In each trial the highest yielding variety was also of high quality.

Mauritius varieties of green peas and turnips which were tested in variety trials at Cameron Highlands were of no value.

A groundnut variety trial of Kedah selections was harvested at Serdang. All six selections gave higher yield than the unselected Kedah variety. The best four lines are now being tested against imported varieties.

Soils.

Studies of soil toxicity were made in relation to sulphur and aluminium. Samples of soil taken from Pulau Gadong Padi Test Station, Malacca, at different depths, while still undried contained little soluble sulphate, but after air drying the amount had increased very greatly in the soil from a depth of 12 to 18 ins. Samples of soil from "gelam" forest in the vicinity did not contain much soluble sulphate before or after drying. These investigations are continuing. A laboratory study was made of the reduction of "active" aluminium by phosphates, in soils from Paya Besar, Pahang, which had a particularly high "active" aluminium content. The "active" aluminium content of the Pulau Gadong soil in the lower horizons was very high.

For determination of organic matter in soils the usual routine is the Walkley Black method. This gives a low recovery with highly organic soils, and methods of wet combustion with dichromate and sulphuric acid have been investigated. So far it has only been possible to obtain about 90 per cent. recovery from glucose as a reference substance. Determinations on soils by wet methods are to be checked by dry combustion.

Improvements are being made in the technique of determining available phosphate and potash in soils by the Neubauer method, using rice seedlings. Tomato plants have been used for experiments on the amelioration of peat. Liming the peat at the rate of 10 tons per acre permits successful growth, where without lime they will scarcely grow at all. The application of copper sulphate alone at the rate of 50 or 100 lbs. per acre had no beneficial effect.

Livestock.

Goats. During the quarter, the following kids were born at Serdang:

British Alpine pure bred	....	2 females
Toggenburg half bred	....	3 males
" " "	....	4 females
Saanen three-quarter bred	....	2 males
" " "	....	1 female

The British Alpine Doe No. 4 which kidded on 25th February had given 1,145 lbs. of milk during 223 days of her previous lactation, an average of 5.1 lbs. per day.

Poultry. In the feeding and management experiment now in progress at several agricultural stations, the Rhode Island Red birds are showing a greater growth rate than the kampong birds. Likewise the birds receiving a balanced ration are mostly showing improved growth and performance over those on kampong rations.

Review

MALAYAN WILD FLOWERS.

BY

M. R. HENDERSON,

Director, Botanic Gardens, Singapore.

Published by Malayan Nature Society.

There has long been an intermittently expressed demand for a simple reference book for identification of the common herbaceous wayside flowers of Malaya, and Mr. M. R. Henderson has achieved his own ambition in supplying that need, through the medium of the Malayan Nature Society.

Malayan Wild Flowers is being published in several parts, as numbers of the *Malayan Nature Journal.* The first two parts have already been published, in December, 1949, and September, 1950, and the third part is now in the hands of the printers.

These first three parts complete the Dicotyledonous flowering plants or families of plants with two seed-leaves. Part 1 deals with the *Polypetalae,* the many petal or free petal group, which includes the Mallow or *Hibiscus* family, the Legumes or Bean family, the Rose and Bramble family, the *Melastoma* or Sendudok family, the Balsams, and the Begonias. Part 2 deals with the *Gamopetalae* or funnel-shaped, or joined-petal group, which includes the *Compositae* or Daisy family, the *Rubiaceae* or Coffee and *Ixora* family, the *Convolvulus* family, the *Labiates* or *Salvia* family, etc. Part 3, *Apetalae* or no petal group, includes the pepper vine, nepenthes (Pitcher Plants), nutmeg, euphorbia, and nettle families.

It is hoped that it will be possible, also, to publish one or two further numbers dealing with the Monocotyledonous orders, which include the lilies, aroids (*Caladium* etc.), orchids, gingers, grasses and sedges.

Malaya is a green country and a tree country, and small herbaceous flowering plants are not conspicuous as are blue-bells, daisies, cowslips and others in England or Ireland, or the bright spring flowers of Australia and South Africa.

There is, however, a very great number and diversity of small flowering species in Malaya, and "the aim of this work is to enable the non-expert to identify a majority of the smaller plants to be found not only in the forest, but by the roadsides, on the seashores, and in the waste spaces of Malaya", perhaps even in and around our gardens.

" The present work.....attempts to give, as it were, a cross-section of the smaller plants of Malaya describing those known to be common, or those most likely to be seen at hill stations." ....."An account, even if short, is given of all families which have herbaceous members."

The introduction, in Part 1, is followed by several pages of descriptions and illustrations of leaf forms and flower types and structures, which will enable any amateur botanist to use, without difficulty, the simple identification key provided at the beginning of each number.

Not many of the local plants have popular English names and are often most easily identified by first of all obtaining the Malay name, and then referring to an appropriate (and available) text book for a precise identification. There is no index of the Malay names provided with *Malayan Wild Flowers* and amatur botanists must, for the good of their minds, use the key and not any quick and lazy method of identification.

These identification keys, however, have been prepared with much thought, and do not contain any difficult technical terms. The descriptions of the various species are very freely illustrated with good line-drawings.

There is only one particular criticism, chiefly of Part 1, and that is, that while only the commonest species can be fully described, these descriptions are not followed by very brief indications of how the various other related and similar plants differ in some recognisable character, such as colour of flower, size of leg, or hairiness of pod. The addition of these notes would be helpful, and many such were in fact added in Part 2.

Jungle walks and wayside rambles are not very often suitable forms of relaxation at present, but many of the small wild flowers are not far to seek as they may be found on the borders of our gardens, and this series of Malayan Nature Society publications provide for a long felt want, and may find a wider and wider appeal.

Individual copies of each part are sold at $6 to non-members of the Society, or at a reduced rate for a complete set, according to availability. They may be obtained from the Hon. Secretary, Malayan Nature Society, c/o Department of Agriculture, Federation of Malaya, Kuala Lumpur.

R.B.J.

Departmental Notes

Promotion.

The Right Honourable the Secretary of State for the Colonies has been pleased to approve the promotion of Mr. O. M. Lee, Senior Lecturer, Acting Principal, College of Agriculture, Malaya, to be Principal, College of Agriculture, Malaya, with effect from the 31st July, 1949.

Appointments.

The Right Honourable the Secretary of State for the Colonies has been pleased to appoint Mr. A. Cumming as Agricultural Development Officer, Federation of Malaya, with effect from the 5th February, 1951. Mr. Cumming is stationed at the Federal Experiment Station, Serdang.

Mr. J. J. Holmes, Assistant to Agricultural Economist, has been appointed to act as Personal Assistant to the Director of Agriculture, in addition to performing his own duties, with effect from the 5th April, 1951.

Mr. R. J. A. W. Lever, Entomologist, has been appointed to act as Senior Entomologist, with effect from the 10th April, 1951.

Leave.

Mr. H. F. Logan, Personal Assistant to the Chief Field Officer, Acting Personal Assistant to the Director of Agriculture, has been granted 150 days leave with effect from the 22nd March, 1951.

Dr. W. N. Scott, Agricultural Officer, has been granted 150 days leave with effect from the 6th April, 1951.

Mr. H. T. Pagden, Senior Entomologist, has been granted 150 days leave with effect from the 13th April, 1951.

Mr. J. A. Cox, Agricultural Development Officer, returned from leave on the 31st January, 1951. Mr. Cox is stationed at the Federal Experiment Station, Serdang.

Mr. J. J. Holmes, Assistant to Agricultural Economist, returned from leave on the 4th April, 1951.

Retirement.

Mr. H. D. Meads, Personal Assistant to the Director of Agriculture, retired on medical grounds with effect from the 1st February, 1951.

MARKET PRICES

January to March, 1951.

Rubber.—The Singapore price of No. 1 R.S.S., f.o.b., in bales, at the beginning of the year was 186 cents per lb. It dropped to 177 cents on the 4th January but had risen to 222 cents per lb. by the 10th January. On the 11th the price dropped to 212 cents and the downward trend continued until 18th when the price was 201½ cents per lb. On the 19th January the price was 207 cents and fluctuated between that figure and 214 cents until the end of the month. The average price in January was 203.98 cents per lb.

In February, the price was 215½ cents per lb. on the 1st, had risen to 237½ cents by the 9th of the month and dropped again to 216½ cents on the 15th February. For the rest of the month the price fluctuated between 216 and 231 cents per lb. The average price for February was 225 cents per lb.

The average price dropped to 216.71 cents in March. The month opened with the price at 226½ cents, and this price was fairly constant until the 9th when it dropped to 212 cents per lb. For the rest of the month the price varied from 204 cents to 221 cents per lb.

Table I.

Average Monthly Prices Paid by Local Dealers for Smallholders' Rubber, January to March, 1951.

(Dollars per picul of 133 1/3 lbs.)

Grades	Taiping, Perak.			Seremban, Negri Sembilan.			Batu Pahat, Johore.		
	Jan.	Feb.	Mar.	Jan.	Feb.	Mar.	Jan.	Feb.	Mar.
Smoked Sheet	225.00	242.50	232.50	238.00	264.00	253.00	196.40	235.95	208.95
Unsmoked Sheet	200.00	210.00	207.50	198.00	220.00	210.00	180.45	202.00	189.80
Scrap	92.50	90.00	90.00	75.00	92.00	75.00	60.95	53.15	46.25

Transport from Batu Pahat to Singapore by lorry, excluding duty, $1 per picul.

Tea.—The most recent price paid for Malayan tea, quoted in the Colombo Brokers' Association report dated 13th March, 1951, was Rs. 2.58 per lb.

The average prices for Ceylon teas quoted in the weekly report of the Colombo Brokers' Association dated 31st March, 1951, were as follows, in rupees per lb.: High Grown Teas Rs. 2.93, Medium Grown Teas Rs. 2.28 and Low Grown Teas Rs. 2.31.

Ceylon teas are subject to an export duty but non-Ceylon teas sold at auctions ex-bond in Colombo for re-export are not subject to this duty.

The retail price of Malayan tea (Boh) is now $2.45 per lb.

Derris.—The average price for this commodity during the first quarter of the year, as quoted in the weekly reports of the Singapore Chamber of Commerce, was $95 per picul.

Tobacco.—The average prices paid per picul for cured leaf in Kelantan during the first quarter of 1951 were as follows:—1st quality $708, 2nd quality $517 and 3rd quality $235.

Rice.—The ration of rice continues to be 3½ katis per person per week. The following are the prices per picul of the three grades of rice:—High Grade $36, Medium Grade $28 and Low Grade $21.

Table II.

Singapore Prices of Various Agricultural Products.

(Dollars per picul)

Date	Copra, Sundried	Coconut oil*	Pepper, F.A.Q. Muntok white	Pepper, Gen. Muntok white	Gambier, Cube	Sago Flour, Lingga	Tapioca Flour No. 1	Oilcake, Round
1951								
2nd Jan. -	47.00	79.00	985.00	995.00	73.00	22.00	20.50	18.00
8th Jan. -	48.50	83.00	990.00	1,000.00	73.00	22.50	21.00	19.00
15th Jan. -	53.00	88.00	1,030.00	1,040.00	70.00	23.25	20.50	20.00
22nd Jan. -	54.00	92.00	1,050.00	1,060.00	70.00	25.00†	22.00	20.00
29th Jan. -	54.00	93.00	1,070.00	1,080.00	69.00	25.00†	22.00	20.50
5th Feb. -	55.25	95.00	1,070.00	1,080.00	69.00	25.00	24.00	21.00
12th Feb. -	56.50	97.00	1,070.00	1,080.00	70.00	25.00†	27.50	21.50
19th Feb. -	58.00	98.00	1,150.00	1,160.00	72.00	25.50†	27.50	21.50
26th Feb. -	60.50	103.00	1,200.00	1,210.00	72.00	27.00	27.50	19.50
5th Mar. -	62.50	108.00	1,155.00	1,165.00	72.00	28.00†	29.00	19.50
12th Mar. -	58.00	103.00	1,080.00	1,090.00	80.00	26.50	28.00	19.00
19th Mar. -	53.00	96.00	1,075.00	1,085.00	80.00	25.75	28.00	18.50
27th Mar. -	55.00	97.00	1,060.00	1,070.00	80.00	25.50	28.00	18.50

* F.O.B. † Nominal.

The above prices are taken from the weekly report of the Singapore Chamber of Commerce.

FEDERATION OF MALAYA
PRODUCTION OF PALM OIL AND KERNELS.

(In long tons as declared by Estates)

Month	Palm Oil		Palm Kernels	
	1950	1951	1950	1951
January	3,959	4,068	896	1,178
February	3,643	3,510	970	970
March	4,861	3,821	1,184	1,196
April	4,918		1,249	
May	4,433		1,086	
June	4,226		1,070	
July	4,361		1,070	
August	4,586		1,193	
September	4,085		1,095	
October	4,859		1,234	
November	4,697		1,168	
December	4,543		1,227	
Total	53,171	(11,399)	13,442	(3,344)

In March 48 estates (planted area 93,669 acres) were in production out of a total of 54 oil palm estates (planted area 96,289 acres).

MALAYAN AGRICULTURAL EXPORTS, OCTOBER-DECEMBER, 1950.

Product	Net Exports in Tons.			
	Year 1948	Year 1949	Oct.-Dec. 1949	Oct.-Dec. 1950
Arecanuts	6,043	5,607	988	4,385
Coconuts fresh † ‡	44,887	21,971	5,490	8,229
Coconut oil ‡	45,245	60,504	12,574	17,601
Copra ‡	28,625 *	24,424 *	7,111 *	1,894 *
Copra cake	12,176 *	27,643 *	5,656 *	8,245 *
Gambier, all kinds	286	293	56	1
Palm Kernels	6,462	8,744	2,633	1,432
Palm Oil	46,821	55,211	12,570	12,590
Pineapples, canned	4,073	8,130	8,137	2,060
Rubber ¶	696,978 ¶	670,257 ¶	173,685 ¶	190,993 ¶
Sago,—flour	16,946 *	1,476	2,247	4,480
„ —pearl	19,084	3,477	393	603
„ —raw	6,667 *	1,317 *	139 *	6,112 *
Tapioca,—flake	304	737	204	208
„ —flour	1,999 *	278 *	491 *	142 *
„ —pearl	14,263	12,345	4,200	3,050
Derris	80	48	6	—
‡ Copra equivalent	45,795	74,334	13,432	26,872

¶ production (Federation of Malaya). † hundreds in number. * net imports.

FEDERATION OF MALAYA RUBBER PRODUCTION.

(In long tons, dry weight)

Month	Estates		Smallholdings (Estimated)		Total	
	1950	1951	1950	1951	1950	1951
January	35,237	29,482	26,618	28,771	61,855	58,253
February	27,297	26,519	22,797	24,313	50,094	50,832
March	27,789	30,591	21,834	30,299	49,623	60,890
April	26,667		21,376	6,327 †	48,043	6,327 †
May	30,870		24,334		55,204	
June	31,196		23,296		54,492	
July	34,547		30,348		64,895	
August	33,316		27,104		60,420	
September	30,323		26,643		56,966	
October	32,256		30,414		62,670	
November	30,138		28,476		58,614	
December	36,217		33,492		69,709	
Total	375,853	(86,592)	316,732	(77,056)	692,585	(163,648)
Total 1949	400,009		270,248		670,257	

Smallholding production is estimated from purchases reported by dealers.

† Quarterly adjustment (deduction of 6,327 tons).

FEDERATION OF MALAYA

PRODUCTION OF COPRA, COCONUT OIL AND COPRA CAKE.

(in tons)

Month	Copra Production						Coconut Oil Production		Copra Cake (Poonac) Manufactured	
	Estates		Smallholdings (estimated)		Total		Oil Mills		Oil Mills	
	1950	1951	1950	1951	1950	1951	1950	1951	1950	1951
January	2,577	2,346	7,765	8,501	10,342	10,847	5,501	5,537	3,634	3,532
February	2,662	2,516	6,868	6,323	9,530	8,839	4,831	4,856	3,182	3,072
March	3,064	3,059	7,062	9,078	10,126	12,137	5,774	5,796	3,798	3,784
April	3,002		7,367		10,369		4,847		3,201	
May	3,424		10,160		13,584		6,507		4,341	
June	3,761		9,109		12,870		6,373		4,176	
July	3,767		9,158		12,925		5,962		3,938	
August	3,580		9,916		13,496		6,315		4,222	
September	3,581		12,593		16,174		6,503		4,168	
October	3,390		11,567		14,957		7,320		4,805	
November	2,807		10,239		13,046		6,312		4,101	
December	2,997		9,062		12,059		6,555		4,253	
Total	38,612	(7,921)	110,866	(23,902)	149,478	(31,823)	72,800	(16,189)	47,819	(10,388)

Notes:—1. The above statistics are compiled and published by the Registrar of Statistics, Federation of Malaya.

2. Estate copra production and coconut oil production are as declared by estates and oil mills respectively.

3. Statistics of smallholding coconut oil production are not available.

4. Smallholding copra production for commercial purposes is estimated from the formula: imports + estate stocks (opening) + estate production + smallholding production = exports + local oil mill consumption + estate stocks (closing).

METEOROLOGICAL SUMMARY, MALAYA, JANUARY, 1951

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes									Number of days							
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F	Total		Most in a day Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more	Total	Daily Mean	Per cent.
										ins.	mm.	ins.						hrs.	hrs.	
Ipoh, Perak	88.5	71.2	79.9	93	68	76	73			11.77	299.0	2.90	27	17	3			151.55	4.89	
Port Swettenham, Selangor	86.7	70.5	78.6	92	67	76	73	82.3	84.0	17.58	446.5	1.74	21		4	3		130.21	4.20	
Kuala Lumpur, Selangor	86.8	71.4	79.1	91	68	76	74			10.25	260.4	2.28	17	16	1	8				
Sitiawan, Perak	87.6	71.5	79.5	92	68	80	73	82.2	84.0	15.93	404.6	2.42	20	17	4	4		143.86	4.64	
Kuala Lipis, Pahang	83.3	70.9	77.1	89	68	75	72	81.2	82.0	9.71	246.6	1.80	21	21		25		100.25	3.23	
Kuantan, Pahang	83.5	70.9	77.2	87	65	77	74			22.29	566.2	4.75	25	23	1	2		103.50	3.34	
Temerloh, Pahang	84.1	70.5	77.3	89	68	78	73			14.35	355.6	3.75	17	17		4		104.00	3.35	
Bayan Lepas, Penang	86.6	73.1	79.9	90	70	81	77			5.63	143.0	2.02	13	10				189.93	6.13	
Malacca	84.4	72.5	78.5	90	70	76	74			5.63	143.0	1.00	20					138.65	4.47	
Mersing, Johore	81.5	73.6	77.5	85	70	78	77			27.06	687.3	5.33	19	16			5	140.95	4.55	
Alor Star, Kedah	87.9	70.9	79.4	92	67	81	74			1.51	38.4	0.74	12	6						
Kota Bharu, Kelantan	82.9	73.5	78.2	84	70	79	77	80.4		8.19	208.0	5.01	20	15		2		199.86	6.45	
K. Trengganu, Trengganu	82.3	72.8	77.5	85	69	77	75			8.74	222.0	3.17	20	15				118.00	3.81	
Kallang Aerodrome (S'pore)	84.9	72.6	78.7	90	69	75	75			24.13	612.9	3.47	22	19	5			130.95	4.22	
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft.	67.9	60.3	64.1	74	58	62	62	68.3	69.6	23.63	600.2	4.36	25	22		26		61.50	1.98	
Cameron Highlands, Tanah Rata, Pahang 4750 ft.	69.3	57.2	63.2	75	48	64	62	66.6	68.6	13.25	336.6	3.26	27	19		1		71.45	2.30	

Compiled from Returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, FEBRUARY, 1951

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes						Total		Most in a day	Number of days					Total	Daily Mean	Per cent.
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F			Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more			
										ins.	mm.	ins.						hrs.	hrs.	
Ipoh, Perak	89.7	71.6	80.7	94	69	80	74			13.62	346.0	2.52	23	20	11		1	152.00	5.43	
Port Swettenham, Selangor	86.9	71.4	79.1	90	69	77	73	83.0	83.8	7.98	202.7	2.26	16		4	1		136.49	4.87	
Kuala Lumpur, Selangor	88.2	72.3	80.3	92	70	78	74			16.54	420.1	5.10	19	17	6	9				
Sitiawan, Perak	87.9	72.2	80.1	92	69	84	74	83.4	83.9	4.57	116.1	0.87	20	17		4		155.35	5.35	
Kuala Lipis, Pahang	86.6	71.3	78.9	92	69	78	74	82.5	82.5	2.67	67.8	0.72	13	13		24		148.35	5.30	
Kuantan, Pahang	86.1	70.3	78.2	90	67	79	74			12.87	326.9	6.75	11	10	1	2		144.15	5.15	
Temerloh, Pahang	87.5	71.2	79.3	92	68	81	74			3.15	80.0	1.00	11	11	1			136.55	4.88	
Bayan Lepas, Penang	87.0	73.3	80.1	89	71	83	76			8.34	211.8	3.30	16	12	2			190.88	6.82	
Malacca	86.0	72.6	79.3	90	71	77	74			4.09	103.9	0.86	17					163.05	5.82	
Mersing, Johore	82.5	72.3	77.4	85	70	79	77			5.71	145.0	2.58	7	6			2	158.50	5.66	
Alor Star, Kedah	90.3	70.6	80.5	93	66	82	73			6.25	158.8	2.81	11	8				214.53	7.66	
Kota Bharu, Kelantan	84.7	72.0	78.3	87	70	82	76	82.5		7.10	180.3	2.43	8	8		6		202.05	7.22	
K. Trengganu, Trengganu	84.3	71.5	77.9	88	69	80	75			5.38	136.7	2.38	7	5		2		189.35	6.76	
Kallang Aerodrome (S'pore)	87.1	73.2	80.1	90	67	79	75			5.37	136.4	1.69	16	12	3			149.70	5.35	
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft.	71.3	60.8	66.1	77	57	64	63	70.0	70.2	4.93	125.2	1.69	16	16				104.20	3.72	
Cameron Highlands, Tanah Rata, Pahang 4750 ft.	71.3	55.0	63.1	75	49	65	62	66.1	67.9	9.15	232.4	1.93	22	22				101.25	3.62	

Compiled from Returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, MARCH, 1951

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes									Number of days							
	A. Max.	B Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F	Total		Most in a day Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more	Total	Daily Mean	Per cent.
										ins.	mm.	ins.						hrs.	hrs.	
Ipoh, Perak	92.7	72.3	82.5	96	68	89	77			6.92	175.8	1.42	14	14	8		1	239.15	7.71	
Port Swettenham, Selangor	90.6	71.5	81.1	93	68	88	74	85.6	85.2	6.64	168.3	1.90	18		4			252.55	8.15	
Kuala Lumpur, Selangor	92.0	72.6	82.3	94	69	90	75			10.72	272.3	1.85	15	14	9	7				
Sitiawan, Perak	89.7	72.6	81.1	92	70	87	76	84.9	85.0	5.95	151.1	1.36	13	13	7	2		240.82	7.77	
Kuala Lipis, Pahang	89.4	71.0	80.2	93	66	85	73	83.9	83.4	3.15	80.0	0.88	12	12	3	24		204.15	6.59	
Kuantan, Pahang	88.5	70.3	79.4	90	65	86	74			3.50	88.8	0.88	12	10	1			228.10	7.36	
Temerloh, Pahang	89.8	71.0	80.4	92	65	84	74			5.58	141.7	0.95	17	16	3	11		215.10	6.94	
Bayan Lepas, Penang	89.0	74.3	81.7	93	71	85	77			1.68	42.7	0.53	12	8	4			263.98	8.51	
Malacca	89.4	73.3	81.3	92	70	86	75			3.75	95.3	0.92	16					264.65	8.54	
Mersing, Johore	85.4	74.2	79.8	88	69	83	78			2.35	59.7	0.72	10	8	1			277.90	8.96	
Alor Star, Kedah	91.9	71.3	81.6	96	27	89	75			3.11	79.0	1.24	5	5	2			277.18	8.94	
Kota Bharu, Kelantan	87.2	72.9	80.1	90	69	84	77	85.3		3.80	96.5	1.54	10	6	1	6		278.95	9.00	
K. Trengganu, Trengganu	86.7	72.3	79.5	89	69	83	76			2.55	64.8	0.99	10	9	2	1		260.45	8.40	
Kallang Aerodrome (S'pore)	89.2	74.2	81.7	92	71	85	77			4.80	121.9	1.33	11	9	4			241.90	7.80	
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft.	73.3	61.0	67.1	77	58	68	63	71.9	71.3	6.26	159.0	1.45	19	16	3	23		178.80	5.77	
Cameron Highlands, Tanah Rata, Pahang 4750 ft.	74.2	56.1	65.1	79	48	69	63	67.3	68.5	3.40	86.4	1.12	17	14				198.75	6.41	

Compiled from Returns supplied by the Malayan Meteorological Service.